AUSTRALIAN SOCIETY FOR LIMNOLOGY

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The Australian Society for Limnology is an association of over 400 people with professional or amateur interests related to Australian inland waters Since its inception in 1961 the Society has played an important role in fostering limnological work in this country. The ASL promotes liason between limnologists in academic, private and governmental institutions and has a vested interest in the conservation of aquatic and related resources. Annual conferences are held near centres of limnological interest, and the programme includes scientific sessions, field excursions and social activities.

The ASL produces a newsletter with notes on activities, articles of general interest, book reviews and conference announcements; a Bulletin of original scientific papers and occasional Special Publications. A further publication is the Directory of Australian Limnologists.

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LIMNOLOGY

NEWSLETTER

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LIMNOLOGY AND NUCLEAR WAR

by Elliott Norse

The following article is reprinted from the Aquatic Ecology Newsletter, which is published by the Aquatic Section of the Ecological Section of the Ecological Society of America. The article is reproduced with the permission of the author and the editor.

Although I have never been an antinuclear activist nor a supporter of peace organisations, my childhood during the era of atmospheric nuclear testing and punctuated by the Cuban missile crisis left me with an ineradicable uneasiness about nuclear weopons. In destructive power they dwarfed everything else. One of their greatest dangers was radiation, insidious and invisible. And in my naivete, I felt that their use was completely unpredictable and determined by forces I did not understand.

I remember seeing government films of the houses on the nuclear testing range, first illuminated by a flash, then charred and ignited, then paroxysmally shaken, then blown away (which, I suspect, is the origin of that now common colloquialism) as if made of feathers rather than lumber. "Alas, Babylon" and "On the Beach" depicted the results of nuclear war in a way that seemed so realistic that I awoke drenched in perspiration more than once. Hollywood and its Japanese analogues also gave us a legion of monster movies ("Them", "Godzilla", "It Came From Beneath the Sea" and "The Beast From 20,000 Fathoms" come to mind), in which nuclear explosions caused nature to run amok, mutating heretofore innocuous creatures into malevolent forms or arousing sleeping marine behemoths to punish mankind for our hubris. These last films were less nightmarish because they seemed so pseudoscientific and implausible (except for the "Beast...," whose invasion of Coney Island in Brooklyn, where I lived, added a personal note of disquieting reality). What I did not know until I began preparing for the October 31 - November 1, 1983 scientific conference in Washington D.C. called "The World After Nuclear War", was that the serious films had underestimated the effects of nuclear war, while the monster movies were closer to the truth than I imagined.

What emerged from the Conference is that in the unlikely circumstance that almost everyone could escape the target areas and follow the reassuring prescription of the Defense Department official to dig a hole, cover it with an old door and throw three feet of earth on it, a major nuclear war would nevertheless dwarf all previous sorties by the apocalyptic horsemen. Even if the long-known, direct, short-term affects of blast, heat and radiation unleashed at detonation failed to take their anticipated toll of up to 2.2 billion people, natural atmospheric and ecological processes would be so altered that the extinction of humankind would be a plausible consequence.

Aquatic ecosystems would not escape these effects. Under a wide variety of scenarios, dust from ground bursts and soot from burning cities and refineries would reduce visible light to 1-5% of normal values for months, leading to a virtual cessation of photosynthesis. This would collapse food webs, especially in ecosystems in which phytoplankton are the primary producers. The pall of particulates would plunge temperatures in the lower troposphere 30-40°C below ambient temperature freezing most freshwaters. Ruptured petrochemical plants would empty their contents into navigable waterways and thence the sea. The sharply accentuated temperature differential between contintal and oceanic airmasses would produce frequent, violent storms. Erosion would increase, enlarging sediment loads to rivers and coastal waters. After the washout and fallout of the atmospheric particulates, the damaged ozone layer would permit increased levels of UV-B radiation to reach the Earth's surface, harming phytoplankton and aquatic macrophytes recovering from the darkness and cold. Models by both the US and the Soviet scientists suggest that these effects would not be confined to the Northern Hemisphere.

While the adult in me ponders this issue in terms of megatons, gigadeaths and teradollars, I harken back to the monster movies of my childhood, for any survivor of the direct, immediate effects of nuclear war which would find nature disturbed to a degree without precedent in the last 65 million years, when, as some geochemists and paleontologists theorize, a gigantic meteor collided with the Earth, plunging the world into Stygian darkness and consigning the real-life Godzillas to extinction.

AUSTRALIAN LIMNOLOGICAL RESEARCH PRIORITIES.

The following is a list of major Australian limnological research priorities prepared by a workshop held at Canberra CAE on Saturday 26 November 1983. The workshop was organised under the auspices of the ASL and the report was forwarded by the President to the Interim Council of the Australian Freshwater Institute.

Although Australia is the driest inhabited continent, we know surprisingly little about its aquatic resources. Whilst considerable emphasis has been placed on water resource availability and the best means of managing and utilising water resources from a supply perspective, we are relatively ignorant about many of the other fundamentally important properties.

As the utilisation of Australian water resources progress from a largely development phase (e.g. building of dams and irrigation networks) to one of better management of existing resources, there will be an increasing need for more detailed limnological information. Almost all of this must come from research in Australia of Australian aquatic systems and not from the uncritical adoption of overseas information. The increasing community concern for water quality ad the continuing development of water quality standards overseas means it is essential that we are in a position to assess the relevance of such overseas standards to Australian environments.

To manage an aquatic system effectively it is necessary to have a detailed understanding of how that system functions. This will involve knowledge of the structure of our aquatic ecosystems and an understanding of the dynamic processes operating, including the interactions between the biological, chemical and physical components. This knowledge will only come from fundamental and applied research on Australian aquatic systems. This research will often need to be conducted over a sufficient period to enable the impact of variable climate on aquatic ecosystems to be understood.

The following list of research priorities was determined at an Australian Society for Limnology workshop and subsequently canvassed amongst other leading members of the Society. These priorities inevitably

reflect the views aand experiences of those who contributed. However, as these include botanists, zoologists, chemists and hydrologists; scientists with collective experiences of working in each State and Territory in Australia, as well as overseas; and people in tertiary education, state authorities and CSIRO, it is unlikely that there would be widespread dissension from such a representative group.

These research needs have been identified to assist the Interim Council in deciding which research to encourage in developing freshwater studies in Australia. Obviously these priority areas are indicative only and must not preclude the support of other research proposals judged to be excellent in quality.

RESEARCH PRIORITIES

The following list of seven limnological research areas is not listed in any particular order of priority, each is considered to be of very high priority for Australia.

A. Distinctive environmental features of Australian waters.

Australian inland waters exhibit a number of distinctive features. These include: wide hydrologic variability; patterns of allochthonous input from eucalypts and other native Australian vegetation and from large quantities of wind-blown dried animal droppings and soil during droughts that are different to those in the northern hemisphere; high and persistent turbidities and a light climate that is affected by this; high susppended solids as a consequence of a range of climatic extremes, drainage patterns and catchment usage; interactions between in-stream and off-stream systems such as flood plains and billabongs; together with peculiar temporal and spatial changes influencing the environment.

The nature and effects of such features require special attention in any study of Australian waters and must also be taken into account in their management. Obviously overseas studies and approaches need careful validation before being applied in Australia.

B. Aquatic Ecology

Much of the Australian aquatic biota is endemic and the distinctive environmental characteristics noted in A. above, have influenced their evolutionary processes. Moreover, interactions between the biota and the environmental features determine the nature of our Australian aquatic ecosystems. Consequently the basic understanding of these systems and the processes acting within them requires much more resolution. Continuing research to gain this knowledge is an essential requirement for improving the management of Australian inland waters.

Such research must include autecological and synecological studies which particularly address trophic ecology, life cycle studies, species habitat requirements and the effects of alteration of flow regime on faunal population dynamics, colonization strategies, transient water bodies and natural community changes over time.

C. Taxonomy and distribution.

The taxonomy of Australian aquatic flora and fauna is inadequately known. Many ecological studies cannot be completely analysed without proper taxonomic information, which includes a knowledge of species integrity, life histories and distribution.

D. Catchment and water body interactions.

The processes which take place in water bodies are often significantly influenced by the materials derived from their catchments. These catchments may supply surface and groundwater flows that contain dissolved and particulate materials derived from natural forests, plantations, agricultural and urban lands. Quantitative understanding of the movement from catchments of not only water, but nutrients, salt, particulate materials and various pollutants is essential for interpreting events in water bodies. The measurement and prediction of the transport of these substances from catchments subjected to erratic rainfalls and different land-use practices

and fire regimes is essential for predicting possible changes in the quantity and quality of Australian waters, and for their sound management for conservation and exploitation.

The behaviour of wetlands in catchments, especially of permanent and transient wetlands bordering streams, has a significant mediating effect on the export of particulates and nutrients to streams. The role of wetlands as either sources or sinks of pollutants, nutrients and turbidity, and their sensitivity to land management practices is an important research area.

E. Implications of flow manipulation.

Most major Australian streams are manipulated by man in order to reallocate water supply from wet seasons to dry seasons. As alternatives such as off-stream storage and catchment manipulation are occasionally employed, flow management is generally achieved by the imposition of barriers forming on-stream reservoirs. Manipulation in this form has a number of ancilliary effects on the host stream including the interruption of animal (particularly fish) migration; inversion of normal seasonal flow patterns (resulting in substantial changes in mainstream and floodplain ecosystems); and a reduction in hydrological variability.

The limnology of regulatory impoundments is also affected by flow regulation which results in periodic changes in depth with resultant effects on banks, benthic organisms and aquatic plants. Finally, the reservoirs influence the water quality of the host stream through "settling out" of suspended material and possibly by changes due to stratification within the reservoir. Coupled with this is the need for an understanding of the ecological dynamics of large storages.

A thorough understanding of all these issues is required for the proper management and conservation of highly manipulated systems, such as the River Murray, as well as the economic development of other rivers such as the Burdikin. Coupled with this is the need for an understanding of the ecological dynamics of large storages.

F. Nutrient dynamics and plant responses.

Nutrients are often the factor that controls plant growth in aquatic ecosystems; land management practices and sewage discharge are often associated with biostimulation, sometimes leading to eutrophic conditions in water bodies. Algal blooms lead to many water quality problems, including toxin production, which are a serious and expensive problem for water users and also reflect profound changes which have occurred through nutrient enrichment in many inland waters.

The movement of nutrients, such as phosphorus and nitrogen, into and within aquatic ecosystems must be understood if decisions on an appropriate level of sewage treatment are to be made.

Particular research needs in Australia relate to predicting nutrient exports from various land uses; the importance of extreme hydrologic events such as floods; the availability of nutrients on particulate material both in suspension and once they are deposited to the bottom of the water body; the importance of hydrodynamics in nutrient dynamics; the role of microbial communities in making nutrients available for aquatic plants; the relationship between nutrient levels and biostimulation and how this can be predicted for any particular water body; and the testing and validation of overseas models for predicting the trophic status of water bodies.

The role of the unique features of Australian ecosystems such as billabongs, transient systems, and redgum wetlands must also be considered both in terms of their response to and effect on nutrients in surface waters.

G. Response of Australian aquatic systems and species to natural and anthropogenic perturbations.

The biological communities in streams, lakes and wetlands are subject to an array of natural and anthropogenic perturbations, including droughts, floods, bushfires, land use changes, agricultural practices and

waste discharges. Australian aquatic systems are generally subject to greater natural disturbance than those in the more widely studied cool temperate Northern Hemisphere areas. In order to manage aquatic systems successfully we need the ability to predict the way communities respond to perturbations. To achieve this understanding it is necessary to study aquatic systems holistically to understand interactions as well as investigating the environmental tolerances and responses of individual species which comprise the biological communities.

"Mr Sniptoad, you have three seconds on the lifespan of the mayfly, starting now . . ."

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Thesis Abstracts

Hybridization between Murray Cod and Trout Cod in Cataract Dam, N.S.W.
By Scott Wajon, B.Sc. (Hons) Thesis, 1983, University of New South Wales.

Hybridization in nature between Murray Cod (Maccullochella peeli) and Trout Cod (M. maquariensis) in Cataract Dam was investigated using morphological and elctrophoretic techniques. The two species showed fixed differences at 28% of the 32 loci surveyed. Fixed differences were found in ALD, ACON, FUM, GPI, GDA, -GAL, PEP, MDH and SDH. Hybrid patterns, not seen in the parental species, were detected at ALD, ACON, MDH and GPI. The genic dissimilarity belies the close ecological, morphological and evolutionary affinities between the species. Hybrid genotypes did not show intermediate patterns at all the fixed difference loci but consisted of a mosaic of parental alleles. This result, plus the fact that ripe gonads have been found in hybrids indicates the hybrids are fertile and introgression has been occurring for a number of generations.

Principal components analysis based on morphology, shows the hybrids represent a range of intergrades between parental extremes. Morphological variability is also indicative of hybrid fertility and introgression.

The proportion of hybrids in the population detected by electrophoresis was 0.5 and by morphology, 0.32. Agreement between techniques in classification of the Cataract cod into two species and hybrids was high and both techniques are sufficiently sensitive to detect introgressed individuals. Two possible natural hybrids from the Murray-Darling system were detected on the basis of morphology.

THE AUSTRALIAN BASS, MACQUARIA NOVEMACULATEA.

by John Harris, Ph.D. Thesis, 1983, University of New South Wales.

The research project reported in this thesis investigated the biology of the Australian bass, Macquaria novaemaculeata (Perciformes : Percichthyidae), a catadromous fish of south-eastern Australia. Bass populations were studied at sites representing main habitats in the Hawkesbury river system and the Sydney Basin, between November 1977 and January 1982.

Aspects examined were age and growth, reproduction, diet, demography (including abundance, mortality, production, and population trends), and migration. Sampling methods included gill-netting, trapping, angling and dip-netting. A variety of standard and innovative experimental, laboratory and analytical techniques were used ; data analysis was facilitated by computer. Stream impoundments in the range of bass were also studied in relation to fish migration and fish passage facilities.

General results from 1071 adults and 7,546 young fish showed that M. novemaculeata is a long-lived, and slow-growing species. Males are smaller than females, and habitat type controls growth. Spawning occurs between late June and early September in the brackish estuarine zone, and is dependant on flooding. Spawning is serial and highly fecund, and eggs are demersal. If flooding does not occur, females remain in fresh water, and ovaries commence involution in September. Females make a precise homing migration after spawning. Larvae recruit to macrophyte beds, and migrate upstream during spring and summer. Populations are sexually segregated, few male juveniles progress above the tidal limit.

Individual bass are sparsely distributed in littoral areas. They are generally solitary, cryptic and crepuscular, with an extensive home range. The diet is carnivorous and generalized, with marked seasonal and habitat variation. Production of adults in a lagoon was low, and the P/B ratio was exceptionally low.

Detrimental changes in bass populations were related to human activities. Recruitment showed a long term decline, and was correlated with winter streamflow, which was suppressed by dams. Declining mean length and age in Hawkesbury fish indicated an increased mortality rate between 1977 an 1982. Impoundments obstructed access to about half the potentially available habitat throughout the range of bass, and the few fishways were rarely effective.

Macquaria novemaculeata is a flexible, well adapted species with morphological, physiological and behavioural characteristics enabling success in its varied, changeable, and sometimes difficult environment.

AN OPTICAL AND ELECTROPHYSIOLOGICAL STUDY OF A REFLECTING SUPERPOSITION EYE.

Ph.D. Thesis, 1982, by Kim Bryceson, Department of Neurobiology, Research School of Biological Sciences, ANU.

The eye of the Australian freshwater crayfish Cherax destructor was investigated using histological, optical and intracellular recording techniques.

The eye has all the required features for a reflecting superposition eye : a square corneal facets; b cones square in cross-section; c birefringent pigment surrounding the distal cone which acts as a multilayer mirror and d an optically clear zone between the proximal tips of the cones and the distal tips of the rhabdoms.

The cornea is made up of an array of square facets each of which focuses light from a distant object (forming a real inverted image), to a position behind the cornea approximately corresponding to that of the distal end of the rhabdom.

A refractive-index gradient in the inner layer of the cornea acts as a lens cylinder which focusses the light.

The anatomy was studied with proper attention to the time of day and the adaptation state. Light microscopy showed that there is an increase of 10-15% in the clear-zone width in the DA state at night compared to the other states. This change is due to a proximal movement of the rhabdom layer, possibly caused by a flattening out of the basement membrane.

The rhabdom varies in diameter over its length; it is shaped like a flask with a narrow tip, a wider shoulder region with the maximum diameter being in the central region. There is no significant change in the tip, shoulder or central diameters on light- and dark-adaptation or from day to night.

The distal screening pigment lies around the distal cones in the dark and moves into the clear zone on light-adaptation. Proximal screening pigments, however, attain only the first stage of dark-adaptation during the day. Complete dark-adaptation (movement below the basement membrane) occurs only at night. The distal reflecting pigment remains around the cones at all times, and the proximal reflecting pigment forms a cup around the base of the rhabdom during both day and night.

The number of facets exhibiting eyeshine in intact animals at different adaptation states and at different times during a 24 hr period, were noted as a measure of the total eye aperture through which light reaching a receptor could enter the eye. The size of the eyeshine patch changes on light- and dark-adaptation. The mechanism responsible is the movement of the distal pigment either into the clear zone in the LA state, decreasing it, or out of the clear zone in the DA state increasing it. The size of the eyeshine patch at night in either adaptation state is the same as during the day.

The colour of the eyeshine patch changes on LA and DA and from day to night. This colour change is discussed in relation to screening pigment movements

Intracellular recordings of acceptance angles were made at different adaptation states, at different times of the day, and in different media (air and water), from retinula cells in the central region of the eye. An intact-animal preparation was developed so that the endocrine and nervous systems couild function normally. Using this preparation it was possible to hold a number of cells for longer than 24hrs.

The acceptance angle in air is greater in the dark-adapted (DA) state than in the light adapted (LA) state, but this difference is significantly smaller at night than during the day. Mean values were 5^{o} (LA day and night), 19^{o} (DA day) and 13^{o} (DA night).

The smaller acceptance angle in the DA state at night compared to that of the DA day state, indicates that the receptors lie closer to the best superposition focus in this state, when the animal is in air.

The effect of the change in clear-zone width and the performance of the eye in air and under water were examined using a model of the eye.

Intracellular recordings of intensity/response functions (V/log I curves) and spectral sensitivities were made at different adaptation states at different times during a 24 hour period, from single receptors in the central region of the eye.

There is a shift in peak wavelength sensitivity (λ_{max}) of 28nm from DA (600nm) to DA night (572 nm). This is attributed to migration of proximal screening pigment below the basement membrane at night.

The intensity required to elicit a criterion response (50% of the maximum) is less at night than in the day in both the dark-adapted (DA) and the light-adapted (LA) states.

Within the first 30 seconds of light-adaptation there is an extremely fast initial decrease in sensitivity which cannot be correlated with the position of the screening pigments.

The time courses of screening pigment movement on light or dark adaptation were measured using light microscopy. As found by de Bruin and Crisp (1957) in several species of prawn and Frixione et al (1979) in the crayfish Procambarus, the proximal pigment migrates faster than the distal pigment on light adaptation. On dark adaptation, the distal pigment migrates faster than the proximal pigment, the latter only carrying out the first stage of dark adaptation during the day.

It is concluded that there are three systems affecting sensitivity in a reflecting superposition eye : (a) the effective rhabdom cross-sectional area and angular acceptance as determined by the position of the proximal pigment; (b) the blur circle diameter and intensity determined by the position of the distal pigment and the width of the clear zone, and (c) transduction gain.

Book Reviews

Miller, R.H. (1983). Freshwater Invertebrates
Gould League of Victoria, Melbourne.
ix + 36 p.p. A$5.00. *Reviewed by I.A.E. Bayly*

This booklet contains excellent illustrations, many of which are original, and is layed out in a most attractive style. Thirteen colour prints (on 2 pages) are also included. For each opening there is a dendrogram type of key on the right side in which one starts at the top of the page and moves towards the bottom in order to key out the animal to

a taxon not below the family level. On the left hand page there are concise, informative notes on the salient general features of the various taxa.

The statement is made at the beginning that the series to which this booklet belongs deal only with macroscopic forms. Fortunately Miller does not adhere religiously to this general constraint so that taxa such as rotifers and copepods (but not harpacticoids), which are usually regarded as essentially "microscopic" are included in the keys. However, protozoans and parasitic organisms are excluded.

I believe that secondary school teachers will find this booklet an excellent aid for freshwater studies. It would also be very useful at the university level when first or second year biology students (not all of whom have done school biology) are introduced to pond life, which they so often are as part of an introductory ecology course. It is not sufficiently detailed in itself for say a third year limnology course at university, but could be used to get a "fix" on the correct family before tackling the generic keys in Bill Williams' "Australian Freshwater Life".

"The Platypus" By Tom Grant (Illustrated by Dominic Fanning). New South Wales University Press, 1984.
ISBN 0 86840 137 4 Recommended retail price $7.95.
Reviewed By Maryanne McKaige.

A first glance at Tom Grant's book "The Platypus" might give the scientific reader the mistaken impression that it is largely a book for the undergraduate, even secondary student. The narrative style, and explanatory sketches by Dominic Fanning,

make it easy reading for anyone with an interest in platypuses, layperson and student alike. Dr. Grant, has, however, mostly achieved his aim of producing a book that is also of value to the professional biologist, providing a synthesis of relevant and recent work (much of which has been done by the author himself) on the biology and behaviour of the animal. Perhaps the greatest problem from the scientific reader's point of view is that references are not cited in the text. This is obviously a compromise in favour of less scientific readers and the bibliography is not so large that a relevant reference cannot be readily located (Dr. Grant refers readers to Mervyn Griffith's "The Biology of Monotremes" (1978) for an exhaustive bibliography).

The introduction gives a biological overview of the platypus, comparing its various anatomical features with those of other animals and outlining the early controversy surrounding its classification, in itself a good lesson for the biology student. A strong feature of the book is the way it explains, in fairly simple terms, various biological principles and systems, such as temperature regulation, in the context of platypus biology and behaviour. For this reason "The Platypus" could be a valuable teaching aid for secondary students of biology.

The remaining (4) chapters each cover a season beginning with winter and adopting an almost "a-day-in-the-life-of-a-platypus" approach. The chapters deal with feeding, temperature regulation, reproduction and development, burrow characteristics, habitat, effects of floods and general behaviour. The results of scientific research are generally presented in an easily assimilated manner, and the layout of the book is simple and effective.

The illustrations by Dominic Fanning are good and, in the case of a somewhat furtive animal like the platypus, probably complement the text better than photographs could. Photographs that are included are well reproduced as are most of the figures. Pictorial pie-diagrams have been used to good effect to show seasonal composition of platypus diet. A major criticism of the figures, and probably the most significant one for the book, is in the poor labelling of several diagrams. The worst examples of this are "The Platypus Skeleton" (Figure 1.3) and "Organisation of the Sensory Cortex in the Platypus Brain" (Figure 4.6). Figure 1.3, which is in fact two figures, includes what is presumed to be a comparison of platypus, reptile and mammal "shoulder girdles" (sic) but this is not evident from either the labelling or the caption. Similarly, Figure 4.6 has a caption referring to labels "(A)" and "(B)" which do not appear on the diagram. The caption states that "The large area...of the brain...receiving information from the bill can be seen", but just where is sure to remain a mystery to the average reader.

Apart from these inconsistencies in Dr. Grant's desire to produce a book acceptable to a broad spectrum of readers, "The Platypus" is an informative and enjoyable book valuable to anyone interested in improving their knowledge of this delightful animal.

Teaching Limnology

The following syllabi were prepared by Professor H.C. Golterman and presented to the Standing Committee on Education at the 1983 SIL Congress in Lyon.

Limnology curriculum

Final version, March, 1983.

Foreward

The prescription should not be seen as binding or obligatory. What is necessary for further limnology is good, inspiring teachers. They should not be inhibited by too many or too strong suggestions.

Essential pre-requisites for a course in limnology

It is difficult to offer all courses mentioned below on smaller universities, e.g. not all universities have the facilities to make the separation of botany and zoology into equal bits of taxonomy and physiology.

Two possibilities are presented here but there are many others depending on the universities and the directions of the limnological research.

	Possibility I	Possibility II
chemistry	200h	200h
physics	100h	50h
biomathematics	40h	—
biostatistics and modelling	—	75h
geology (earth surface processes, soil sciences)	20h	50h

hydrology	5h	25h
botany systematics	100h	—
physiology	100h	—
zoology systematics	100h	—
physiology	100h	—
botany/zoology (systematics/physiol.)	—	200h
general ecology	40h	200h
	805h	800h

Based on 5 week courses four times per year, just before or after B.Sc. (It is supposed that a student works 40 hours a week. For the above mentioned program 20 weeks are thus needed; four periods of five weeks long. That is; 1/2 of a full academic year; academic year = 40 working weeks).

The teachers should be aware of and communicate to students the special ways of field limnology is organized, ways not often met in their pre-requisite sciences.

Advanced course in limnology (M.Sc. level)

Where this material is not covered in the undergraduate course.

Period of teaching: 200h (= 5 weeks): if not so much time is available some subjects may be replaced by text readings.

The course outline does not specify quantitative work per se, although it is implicit in much of what is suggested.

The teaching people should feel free to shortening some sections and to expanding others and integrating topics with each other, and with applied problems. The section special topics is a summary of different possibilites: the actual topics which can be covered will depend on the staff available, their particular expertise, and the equipment and facilities which can be called upon.

	Theoretical lectures	Practical work
1) Morphology, geology	2h	—
2) Water physics	4h	4h
3) Water chemistry	12h	18h

4) Phytoplankton (bacteria, fungi)		
taxonomy	2h	8h
physiology and seasonal succession	6h	12h
aut-ecology, community studies	4h	10h
5) Zooplankton, nekton (fish)		
taxonomy	2h	10h
physiology (energy) and feeding	4h	2h
ecology	4h	—
6) Littoral and benthos	4h	6h
7) Special topics		
chemical, biol. stratification	4h	4h
sediments, mud-water interface		
- pollution eutrophication pesticides heavy metals	4h	4h
- aquacultures		
- running water		
- lake management		
- paleo-limnology		
Total 1-7	52h	78h
8) Field exercises		70h
Total 1-8	200 hours	

Proposals for practical work

1) Determination of the morphometry of ponds and small lakes.

2) Thermal stratification, water movements (waves, seiches), light climate.

3) Analytic work to learn the different determination techniques of pH, redox; major elements; organic chemistry; nutrient cycles; silicate.

4) Taxonomy:

- study of several groups of plankton algae by means of fixed material (taken from nature at mass developments)

- study of fresh samples: to take photos.; to make drawings; use of the inverted microscope.

Physiology and seasonal succession:

- succession in batch cultures
- primary production
- decomposition of organic material (BOD..)

Exercises with bacteria:

- countings of the total number on plate count agar, coliforms, enterococcus
- relation to pollution

Aut-ecology:

- living properties of some species (experiments with pure cultures)

5) Taxonomy:

- study of several groups of zooplankton: Ciliata, rotatoria, heliozoa, crustacea.

Physiology/Energy:

- study of daily vertical migration
- study of zooplankton population structure

6) Determination of algal species from the littoral

Determination of animals (invertebrates)

Distribution and frequency of species along a line vertical to the lake shore.

7) Influence of inflow on stratification

Influence of wastewater inflow on chemistry and bacteriology: Lakes and rivers (self purification)

Coring exercises: Distribution of pigments and heavy metals in sediments, diatoms, pollen, animal parts, charcoal etc.

The techniques of bioassays

Changes of periphyton or/and invertebrate communities from source downstream

Influence of lake management on thermal stratification and hypolimnetic oxygen content of the water.

This lyric was passed on to me by Bill Williams. Bill received it from Gerry "Textbook Of Limnology" Cole. Neither of us know the author, or if Professor Cole knows the author but we hope it isn't copyright.

LIMNOLOGY

Melody : There is a Tavern in the Town

There is a mystic fairy realm -- fairy realm
  Beneath the water's surface film -- surface film
Where plants and worms and fish associate,
  In food complexes intricate.

Oh the wondrous life aquatic
  Where by instincts automatic
Every being seeks its proper place in life -- in life
  The anaerobes down in the holes -- in the holes
  The clams and snails up on the shoals -- on the shoals
And many wonders all unknown to me,
  Until I took limnology.

Oh in Lake Douglas' deepest pool -- deepest pool
  The summer time is always cool -- always cool
There are no storms or winds to fear,
  And the overturn comes twice a year.

Oh the wondrous life pelagic
  Where wee creatures as by magic
Dart through water where gyrinids whirl and dive -- and dive
  Where salts and gases ionize -- ionize
  And every day some new surprise -- new surprise
One of life's mysteries is revealed to me,
  While working on limnology.

RIVER MURRAY UPDATE

Keith Walker has provided an update of the Adelaide University research on the Lower Murray. Since the last newsletter the two honours students have finalised their projects which are now a little different to the outlines given previously.

Tony Woolford is now investigating the problems caused to Riverland irrigators and domestic water users by growths of mussels (Velesunio ambiguus) and cockles (Corbiculina angasi) in supply mains. The shells cause pipe blockages and may foul domestic water supplies. Chlorination is obviated, for reason of cost, and other molluscicides may not be applicable, for obvious reasons. The project will formulate recommendations for the best means of control, and field and laboratory work will focus mostly upon Corbiculina. This will complement information already available for Velesunio and, it is hoped, will suggest some basis for a biological solution to the problem.

Brendan Atkins is looking at the diet of bony bream. Although this species is generally regarded as a mud feeder ("iliophagous"), there is evidence from preliminary gut analyses and other observations that this is an over-simplification. Brendan's work will involve dietary analyses of electrofished and gill-netted population samples, and laboratory studies of the functional anatomy and physiology of the sprcies in relation to diet. This will help to establish the extent of dietary overlap between bony bream and other native and introduced species.

KISSIMMEE RIVER RESTORATION

In the 1960s the US Army Corps of Engineers straightened out the 92-mile meandering Kissimmee River in southern Florida "to prevent flooding"; they turned it into a straight 54-mile canal. It cost $29 million to do, and proved a disaster because creating the Kissimmee Ditch (the canal) destroyed 40,000 acres of marshland which had provided a holding area for southern Florida's vital freshwater supply including that for Miami, and

drained 100,000 acres of wetlands. On 9 September 1983 officials of the South Florida Water Management District decided to begin the work of restoring the river to its original meandering channel, "the first attempt in the US to restore a major river to its original condition". They decided to start with an experimental 12-mile stretch, which they hope to convert in two years, and to spend $1 million on the first mile. The final cost may be up to $200 million. In addition the cattle ranchers threaten to sue over the loss of the new grazing land they acquired with the drainage.

PROTECTION OF FREE FLOWING RIVERS FROM RIVER ENGINEERING

NOTING that undammed wild and scenic rivers provide a broad range of fish and wildlife values as well as scenic and recreational opportunities;

NOTING ALSO that free flowing rivers are increasingly being dammed for hydro-electric power generation and modified by other river engineering works and have all but vanished from some nations of the world;

AWARE that concern for retaining unmodified rivers is mounting in many parts of the world because of the need to retain ecological diversity as directed by the World Conservation Strategy;

AWARE ALSO of the trend towards further development of hydro-electric energy;

CONCERNED for the maintenance of riverine environments and of ecological, scenic, landscape and recreational diversity offered by the natural flow of rivers through gorges, rapids, waterfalls, forests and wetlands;

The General Assembly of IUCN, at its 15th Session in Christchurch, New Zealand, 11-23 October 1981:

URGES States to set aside permanently, representative examples of their free-flowing rivers, or, where this is not practicable, sections of such rivers, from hydro-damming and other river engineering works, to balance those now permanently lost by modification, and to protect the diversity of ecological, recreational, scenic, and landscape values only ensured by retaining the natural flow of rivers; and

RECOMMENDS that classification and management of such designated rivers be the responsibility of an agency whose primary concern is conservation.

INLAND AQUATIC RESEARCH IN WESTERN AUSTRALIA

This informal seminar-discussion group has met in September and December 1983 and our first meeting for this year was in March.

At the September meeting there were short talks on:

1. The ecology of Dunaliella salina (Chlorophycaea, Volvocales) in the hypersaline lake Hutt Lagoon, W.A.
   Tim Moulton (Roche Algal Biotechnology)
2. Biology of the Shannon Mud Minnow (Lepidogalaxias salamandroides)
   Brad Pusey (Zoology,University of W.A.)
3. Iron in lampreys
   Simon Smalley (Life Sciences, Murdoch UNiversity)
4. Feasibility study of management options for the Peel-Harvey estuary
   Bob Humphries (Centre for Water Research, University of W.A.)

In December we heard talks on:

1. Fish Studies in the Peel Inlet
   Neil Loneragan (Murdoch University)
2. Freshwater research at Fisheries and Wildlife
   Noel Morrissey (Dept. of Fisheries and Wildlife)

and in March, there were talks on:

1. Creation of artificial wetlands after clay mining at Wellard
   Owen Nichols (ALCOA)
2. Reproductive physiology and fecundity of Coho salmon
   Peter Morrison (Zoology, University of W.A.)
3. Research in environmental fluid dynamics at U.W.A.
   Stephen Monismith (Centre for Water Research, University of W.A.)

The group has formed a committee to organise the 1985 A.S.L. conference and we hope to have information on a venue and a theme before the Mt. Gambier congress in May. The inventory of current inland aquatic research in W.A. has now been published and should also be available at the Mt. Gambier congress.

Jane Chambers	Dave Macey	Jenny Davis
Botany	Life Sciences	Dept. Civil Engineering
University of W.A.	Murdoch University	University of W.A.

FOR SALE

One copy of Bishop, J.E., (1973) The Limnology of a Small Malayan River, Sungai Gombak. Junk. In good condition $40 or nearest offer. Contact I. Campbell.

AQUATIC INSECT CONFERENCES IN AUSTRALIA

Both the International Ephemeroptera Conference and the International Plecoptera Conference are to be held in Australia following the Hamilton (NZ) SIL Congress in February 1987. The two congresses will be held consecutively with some joint sessions, and this will be the first time that they have been held together. The venue is likely to be Marysville in Victoria.

MIKE TAKES THE PLUNGE

Mike Jones the inimitable Magela Creek chemist from the Chisholm Water Studies Centre was married on March 30th. We wish Mike and Sue well for the future.

NEW MEMBERS

The society welcomes the following new members :

John Anderson, Arthur Rylah Institute, Sheparton Vic.

C.J. Bourke, Sandy Bay Tasmania.

Barry Noller, Office of the Supervising Scientist, Jabiru NT.

Norrie Sanders, ACT.

Jean Jackson, University of Adelaide.

John Gray, University of Adelaide.

SEX CHANGE

Under the list of new members in the last issue I listed Andrea Fleming who would now prefer to be known as Andrew Fleming!

LIMNOLOGY BIBLIOGRAPHY

Russ Tait reports a good response to the call for papers for the limnology bibliography. Remember that the effectiveness of the bibliography depends on members informing Russ about their new publications or new publications they encounter which are relevant to the interests of members. You can find the address to send information on page 10.

AGM Minutes

Minutes of the 22nd Annual General Meeting of the Australian Society for Limnology, held at Griffith University, Brisbane 22 May 1983

1. The meeting opened at 4.40 pm

2. The agenda as circulated was adopted.

3. Apologies were received from P. Tyler, A. Richardson, R. Swain, R. Tilzey, B. Williams, K. Walker, H. Daly, I. McKelvie, M. Birch, F. Reynolds, T. Scribner, P. Breen, D. Hume, R. Gaymer and D. Griffith.

4. Minutes of the previous meeting were accepted on the motion of P. Suter, seconded L. Barmuta.

5. **Matter arising from the minutes:**

The ASL library is probably to go to the Barrsmith Library, University of Adelaide. Negotiations are still underway for this.

6. **Correspondence**

M. Hart reported that all correspondence was of a routine nature and had been dealt with.

7. **President's report**

The Society has had a busy, active and productive year with a considerable amount being achieved, thanks largely to Margaret Hart, our Secretary/Treasurer whom I seem to telephone at the most inconvenient times!

It has been a privilege to serve the Society as its President for the past year. Amongst the many privileges, I have particularly valued the opportunity that it presented to me of maintaining regular contact with fellow limnologists. I have found this both an aid to sanity and a means of increasing my knowledge about limnology, the defacating habits of dogs in London, and picturesque Australian phrases.

During the past year the Executive has had a total of six meetings. These have been very well attended considering the widespread distribution of

the members of the Executive. We have discussed a number of matters and reached decisions on those that we could.

We have investigated the possibility of placing the Society's Library with the Barrsmith Library at the University of Adelaide and this has now been resolved. From now on the Library items we receive will be sent to the Barrsmith Library for them to process and house for us.

We have commenced a bibliography of Australian Limnology in the Newsletter and Russell Tait is to be thanked for arranging to bring this about. We hope that the bibliography will be useful. To some extent its usefulness will depend upon the contributions which members of the Society make towards it.

We have decided to recommend to the Society that the responsibilities for Secretary and Treasurer be split between two people on the Executive. A constitutional amendment will be presented to you later on in the Meeting for your consideration. We will also be recommending an honorarium to be paid to the Treasurer.

We have decided to establish a list of standing rules and decisions reached by the Executive.

At Frank Burns' suggestion we investigated the possiblity of making available funds to assist a student to attend the Annual Conference of the Society. Frank compared similar schemes in other Societies and produced a set of very useful guidelines which the Executive have followed in making awards for this Conference. This will now be an annual award.

We have considered the matter of planning conferences several years in advance. This matter will be discussed later at this meeting.

It became apparent that there were a number of occasions when the Executive wished to sound out members of the Society for their opinions. Clearly it was not possible to write to each member of the Society and so we have established a list of about 10 'key members' who are regionally well-placed to consult with other members of the Society who may be near them.

The Society has, with the assistance of its Editor, produced a number of publications during the past year. A report of this will be presented to you later in the meeting.

The Executive has organised a number of submissions on behalf of the Society to various Committees and in response to requests we have received. In this regard we have made submissions to the Committee set up by the Prime

Minister to investigate Water Needs to the Year 2000. Bill Williams represented us at a meeting in Canberra that was investigating the production of an account of the history of Australian science to coincide with the 200th Anniversary of the founding of the country.

The executive Committee has made considerable efforts to promote limnology as a field of science requiring considerable further support than it currently receives. In this connection your Vice-President, Barry Hart, and I spent a day in Canberra where we spoke with senior people in CSIRO and the Department of National Development and Energy. I, as President, have also written to key members of the Society requesting comments on ideas for the development of limnology within CSIRO. I received a very interesting and useful set of ideas and comments, some of which I was able to incorporate in my address to the Society earlier in the Conference.

That brings me to the current Conference, which I am sure you will all agree has been a marked success. On your behalf, I wish to warmly thank Angela Arthington, Des Connell and all their helpers. Not only has the Conference been scientifically stimulating, it has also been socially enjoyable as I am sure you will all agree.

Finally, I would like to thank all members of the outgoing committee for their support to me personally and on your behalf, for everying they have done to carry forward the subject of limnology during the past year. I especially wish to thank Margaret Hart for her forebearance and for the considerable amount of work she has done to further the aims of the Society. I also wish to thank Barry Hart for all he has done both for the Society and to assist Margaret. I hope that the incoming Executive Committee have as enjoyable a year as we have had and I give them my best wishes.

8. **Secretary's Report**

Margaret Hart reported that there were currently 360 active members. A small number of members were unfinancial and accounts had been sent to them. The number of members subscribing to AJMFR had remained stable. Due to a change in policy by CSIRO, ASL members may now subscribe to more than one journal through ASL.

ASL membership is now on computer, as is information for the next Directory.

Margaret thanked Angela Arthington for her organisation of the congress.

9. **Treasuer's Report**

The Financial statement was tabled and accepted with one correction. It was noted that postage for special publications had become a major item of expenditure at about $150-$200 per issue.

10. **Auditor's Report**

The Auditors report was read and accepted by the meeting.

11. **Editor's Report**

R. White reported that 3 newsletters, 2 bulletins, 2 special publications and 1 co-operative publication were published over the past year. He apologised for Bulletin number 8 being late. The next special publication by Leighton Llewellyn has been sent to the printers. The special publication published jointly with C.I.T. was not numbered because it was not strictly a special publication of this society.

R. White supported the work being carried out by R. Tait on the bibliography and asked members to provide details of their publications to R. Tait.

R. White suggested that the next Editoral Committee should look at typesetting publications.

12. **Jolly Award Committee Report**

P.S. Lake reported that no nominations were made this year.

13. **Student Award Committee**

P. Suter, as chairman of the committee, noted that the standard was high and that the committee had taken into account the fact that they were comparing work from Honours level to the fifth year of a PhD. The award was presented to John Benzie.

14. **23rd Congress**

P. Suter recommended Mt Gambier. This to be considered by the incoming executive.

D. Mitchell recommended that congresses be considered up to 3 years in advance for easier organisation. He then suggested the 24th congress be held

in Perth in 1985. The themes of Rural Streams or groundwater should be considered for this congress.

D. Mitchell also proposed that the anniversary 25th congress be held in Melbourne as the first congress was held in Melbourne.

15. **Field Workshop**

D. Mitchell reported that he had recently attended a successful one week field workshop organised by the Australasian Society for Phycology and Aquatic Botany and recommended that ASL hold similar workshops.

16. **Constitutional Alterations**

The proposed alterations to the constitution as printed in ASL newsletter volume 21 number 1 (pp. 17+18) were accepted.

Changes to section 8 Management, proposed I. Campbell, seconded J. Bishop, passed.

Changes to section 9 Finance, 12 Annual Reports, 4 Membership part c, proposed P. Suter, seconded A. Morison, passes.

Changes to section 4 membership - life membership category, proposed R. White, seconded L. Barmuta, passed.

General Business

1. R. White moved that any life membership payments received in the next twelve months be deposited in an interest bearing account and not be moved until next year when the executive will present to the AGM a constitutional ammendment for management of the life membership account. Seconded John Blyth, passed.

2. Jolly Award. I. Bayly reminded the committee that nominations were to be considered for a set period of five or ten years and therefore there may be nominations from previous years that should be considered. I. Bayly moved that the incoming executive ask the Jolly award committee to call for nominations for the Jolly Award for 1983 and consider any resulting nominations together with any nominations still standing from previous years. If they consider an award for 1983 is warranted, it should be awarded as soon as possible. Seconded F. Burns, passed.

3. B. Hart suggested that the incoming executive include procedures of the Jolly Award Committee in the update of standing orders.

4. Election of Office Bearers:

The following were elected unopposed:

President: Barry Hart

Vice-Presdient: John Kirk

Secretary: Ros St Clair

Treasurer/Membership Officer: Margaret Hart

Executive: John Benzie, Russell Tait, Russell Shiel, Jane Chambers, Phillip Suter, Paul Harvey, Keith Bishop, Sandy Morison.

Ian Hiscock was appointed Auditor for the 1983/84 financial year.

5. R. White recommended that membership fees be increased to cover increasing costs. After discussion the following scale of fees was accepted: Ordinary Member - $15, Affiliated Societies and Institutions - $20, Student Members - $6, Life Members - $200.

6. R. White suggested that the incoming executive should look at ways of spending the additional funds to boost the Society.

7. R. White moved that an honararium of $500 be paid to M. Hart for work as Secretary/Treasurer in 1982-83, seconded P. Sinclair, passed.

8. Stream Survey Group

J. Blyth moved that the recently formed Victorian Stream Survey Group be accepted as an affiliated body of ASL, seconded I. Campbell, passed.

9. AJMFR Funding

D. Pollard reported that cuts in funding were causing problems in production of AJMFR. I. Campbell proposed that ASL send a letter to the executive of the CSIRO, a) expressing concern on past funding cuts and the detrimental effect this had on the scientific community and b) asking for more money and staff for AJMFR. Seconded K. Bishop, passed.

10. Student Travel Awards

F. Burns described the assistance given to students for travel to congresses to present a paper. In this first year of the scheme, 4 students were supported. He suggested in future applicants be asked to give an estimate on the application form of the cost of attending the congress.

11. D. Mitchell reported that a congress on Southern Hemisphere Limnology would be held in South Africa in 1984, and the SIL was considering supporting it.

The meeting closed at 6.45 pm.

Coming Events

10 to 12 June 1984

Water Quality Evolution Within the Hydrological Cycle of Watersheds.

Venue : Quebec, Canada.

Details : H. Whiteley , CHS:84 Program Chairman, School of Engineering, University of Guelph , Guelph , Ontario N1G 2W1 , Canada.

2 to 6 July 1984

Municipal Wastewater Treatment Course

Venue : University of NSW

Details : Professional Education Office, School of Civil Engineering, UNSW , PO Box 1 , Kensington 2033.

3 to 13 July 1984

Perspectives in Southern Hemisphere Limnology

Venue : Wilderness, South Africa.

Details : Ecosystem Programmes, CSP, CSIRO, PO Box 395, Pretoria 0001, South Africa.

13 to 17 August 1984

Fourth International Conference on Mediterranean Ecosystems.

Venue : University of Western Australia

Theme : Resilience in Mediterranean Ecosystems

Details : MEDECOS , Botany Dept , University of Western Australia, Nedlands, W.A. 6009.

13 to 17 August 1984

Second International Conference on Copepoda

Venue : Ottawa, Canada

Details : The Secretariat, International Conference on Copepoda, University of Ottawa, 648 King Edward Avenue, Ottawa, Ontario, Canada K1N 6N5.

17 to 20 August 1984

11th Annual Congress, Australian Society for Fish Biology.

Venue : Glenelg, South Australia.

Details : S. Montgomery, Division of Fisheries, P.O. Box K220, Haymarket NSW, 2000.

20 to 26 August 1984

17th International Congress of Entomology

Venue : Hamburg, Germany

Details : Dr T. Tischler, Zoologisches Institut, Universitat Kiel, Olshausenstr. 40/60 D-2300 Kiel 1 , Federal Republic of Germany.

23 to 24 August 1984

The Ecology of Biological Invasions

Venue : Canberra

Details : Australian Academy of Sciences

28 to 29 August 1984

Ecological Society of Australia Meeting

Venue : Sydney

Theme : Are Australian Ecosystems Different ?

Details : Dr M. Westoby, Biology Dept , Macquarie University, North Ryde, NSW 2113.

27-31 August 1984

Conservation and Management of World Lake Environment

Venue : Shiga, Japan.

Details : Dr. Tatuo Kira, Chairman of the Executive Committee, c/- Shiga Prefectural Government, 4-1-1 Kyomachi, Otsu, Shiga 520, Japan.

28 April - 5 May 1985

11th Federal Convention AWWA

Venue : Melbourne

Details : F.J. Carter, Secretary, AWWA, Box A232 PO Sydney South, 2001.

September 1985

24 Annual Congress, Australian Society for Limnology.

Venue : Western Australia.

Details : Margaret Hart, 22 Netherby Ave, Mulgrave 3170.

8 to 14 February 1987.

XXIII Congress of the International Association of Theoretical and Applied Limnology (S.I.L.)

Venue : Hamilton, New Zealand.

Details : Theme : Water, to use and enjoy. Further information will become available through Tyler.

February 1987

Fifth International Conference on Ephemeroptera.

Venue : Marysville, Victoria.

Details : Dr I. Campbell, Water Studies Centre, Chisholm Institute of Technology, East Caulfield 3145.

February 1987

Ninth International Conference on Plecoptera.

Venue : Marysville, Victoria.

Details : Dr I. Campbell, Water Studies Centre, Chisholm Institute of Technology, East Caulfield 3145.

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